

WHAT IS CLAIMED IS:

- Claim 13*
1. A semiconductor device comprising:
a semiconductor substrate of a first conductivity type;
a first region of a second conductivity type formed on and in direct contact with said semiconductor substrate;
a second region of the second conductivity type formed at and near the surface of said first region;
a third region of the first conductivity type formed at and near the surface of said first region, and surrounding said second region;
a first electrode portion formed on the surface of said third region located between said first and second regions with an insulating film therebetween;
a second electrode portion connected to said second region;
a third electrode portion connected to said first region and spaced by a distance from said third region; and
a fourth region of the first conductivity type formed at and near the surface of said first region between said third electrode portion and said third region;
said fourth region having a depth changing as a position moves in a direction crossing a direction of flow of the current.

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2. The semiconductor device according to claim 1, further comprising:

fig. 30

3rd electrode [] connected to [] not [] of claim 1.

a fifth region of the first conductivity type surrounding said third electrode portion, and formed at and near the surface of said first region.

- fig. 22*
3. The semiconductor device according to claim 1, wherein said fourth region is fixed to a constant potential.

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- fig. 22*
4. The semiconductor device according to claim 3, wherein said fourth region is electrically connected to [said first electrode portion] or said second electrode portion.

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5 5. The semiconductor device according to claim 1, wherein
said fourth regions are formed discretely, and
the neighboring fourth regions are spaced from each other by a
distance allowing connection between depletion layers extending from the
neighboring fourth regions, respectively, in an on state.

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5 6. The semiconductor device according to claim 5, wherein
assuming that said first region has an impurity concentration of $[N_A]$,
said fourth region has an impurity concentration of $[N_D]$, the neighboring
fourth regions are spaced by a distance of W , a required breakdown voltage
is V , an amount of charges is q , a dielectric constant of the vacuum is ϵ , a
relative dielectric constant of silicon is ϵ' , and the impurity concentration
 N_A is sufficiently larger than the impurity concentration N_D , and is
substantially infinite, the following formulas are satisfied:

10 $V > qN_D W^2 / (8\epsilon\epsilon')$
 $W < 2(2V\epsilon\epsilon' / (qN_D))^{(1/2)}$

5 7. A semiconductor device comprising:
a semiconductor substrate of a first conductivity type;
a first region of a second conductivity type formed on and in direct
contact with said semiconductor substrate;
a second region of the second conductivity type formed at and near
the surface of said first region;
a third region of said first conductivity type formed at and near the
surface of said first region, and surrounding said second region;
a first electrode portion connected to said third region;
10 a second electrode portion connected to said second region;
a third electrode portion spaced from said third region by a distance,
and connected to said first region; and
a fourth region of the first conductivity type formed at and near the
surface of said first region between said third electrode portion and said
third region;
15 said fourth region having a depth changing as a position moves in a

direction crossing a direction of flow of the current.

8. The semiconductor device according to claim 7, wherein said fourth region is fixed to a constant potential.

9. The semiconductor device according to claim 8, wherein said fourth region is electrically connected to said first electrode portion or [said second electrode portion].

10. The semiconductor device according to claim 7, wherein [said fourth regions] are formed discretely, and the neighboring fourth regions are spaced from each other by a distance allowing connection between depletion layers extending from the neighboring fourth regions, respectively, in an on state.

11. The semiconductor device according to claim 10, wherein assuming that said first region has an impurity concentration of $[N_A]$, said fourth region has an impurity concentration of $[N_D]$, the neighboring fourth regions are spaced by a distance of W , a required breakdown voltage is V , an amount of charges is q , a dielectric constant of the vacuum is ϵ , a relative dielectric constant of silicon is ϵ' , and the impurity concentration N_A is sufficiently larger than the impurity concentration N_D , and is substantially infinite, the following formulas are satisfied:

$$V > qN_D W^2 / (8\epsilon\epsilon')$$

$$W < 2(2V\epsilon\epsilon' / (qN_D))^{(1/2)}$$

add A5